



## Mark Scheme (Results)

January 2019

BTEC Level 3 National in Applied  
Science/Forensic and Criminal  
Investigation  
Unit 3: Science Investigation Skills  
(31619H)



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# Unit 3: Science Investigation Skills – sample marking grid

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## General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

## Specific marking guidance

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The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

Question Number	Answer	Additional Guidance	Mark
1 (a)	<p>results table containing</p> <p>suitable headings with units (1)</p> <p>measurements consistently recorded to the same precision (1)</p> <p>repeats given and means calculated (1)</p>	<p>voltage/p.d. / potential difference units (V) or volts (number of) lamps or bulbs or lights</p> <p>each voltage column with a voltage heading or covered by a voltage heading with units</p> <p>a minimum of 2 decimal places</p> <p>mean to same number of decimal places as readings.</p> <p>readings for each of the six lamps to be repeated</p> <p>ringed anomaly not to be included in mean</p>	3
1 (b)	<p>graph containing</p> <p>labels and units for axes (1)</p> <p>suitable scales (1)</p> <p>all points plotted correctly <b>and</b> suitable line of best fit (1)</p>	<p>allow reverse axes voltage/p.d. / potential difference units (V) or volts (number of lamps) or bulbs or lights Do not accept volts as a label</p> <p>spread of plots to cover half of the graph paper</p> <p>origin is not required</p> <p>do not accept averages used as scale points</p> <p>accept a bar chart</p>	

		<p>+/- half square for plotted points</p> <p>do not accept straight line from scale of averages</p> <p>allow curve or straight line, not tramlines</p> <p>curve must be smooth not necessarily through all points</p> <p>straight line of best fit must have points evenly distributed about the line.</p> <p>take ringed points as outliers if noted as anomalies in table</p>	
1 (c)(i)	number of lamps	accept lamps/bulbs	1
1 (c)(ii)	Voltage	accept potential difference/p.d.	1
1 (d)	<p>A description which includes:</p> <p>as the number of lamps (in parallel) increases the voltage decreases/negative correlation (1)</p> <p>non-linear/not straight (relationship) or linear / straight line (1)</p>	<p>answer consistent with result from graph or table</p> <p>ignore references to direct proportionality, inverse proportionality and lines not passing through the origin</p>	2
1 (e)	<p>Any two of the following:</p> <p>as more lamps are added, the brightness of (all) the lamps {reduces/ decreases} (1)</p> <p>voltage decreases as the brightness decreases (1)</p> <p>(lamps in a set) are all the same (brightness) (1)</p>	allow 'almost the same brightness'	2
1 (f)	An explanation giving identification and expansion:		2

	<p>Identification (opening the switch) stops the current/stops the circuit/stops the flow of electrons/ breaks the circuit</p> <p>Expansion (any one of the following)</p> <p>stops cell/batteries/ lamps/equipment from overheating (1)</p> <p>allows cell/batteries/ lamps/equipment to cool down (1)</p> <p>gives cells time to recover (1)</p> <p>prevents battery from draining/going flat (1)</p> <p>prevents changes to the resistance of the lamp/bulb (1)</p> <p>allows consistent results to be achieved (1)</p>	<p>One mark can be awarded for an expansion without an identification being given</p> <p>Ignore switches overheating</p> <p>Ignore voltmeter reading changes</p>	
total			14 marks

Question Number	Answer	Additional guidance	Mark
2 (a)(i)	any value between 0.93(V) and 0.97 (V) inclusive		1
2 (a)(ii)	extension of line of best fit cutting x and y axes (from graph) (1)	continuation of straight line judged by eye	1
2 (b)(i)	1.52(V) to 1.60(V) inclusive		1
2 (b) (ii)	1.52 (A) to 1.56(A) inclusive		1
2 (b)(iii)	substitution (1) 1.56/ 1.54  evaluation (1) 1.01 (V/A)	ecf for substitution from b(i) and b(ii). Substitution must be seen to award this mark if the evaluation is out of range  accept any value between 0.93(V/A and 1.09(V/A) inclusive including 1(V/A)	2

	substitution (1) $1.26 \times 0.31$  evaluation (1) $0.39(W)$	accept $0.3906(W)$  do not accept $0.4(W)$ if $0.39(W)$ is not seen in the calculation  accept for one mark a reverse calculation giving $0.317 (A)$ or $1.29(V)$	2
2 (c)(ii)	substitution (1) $0.4 = \frac{9360}{\text{time}}$  rearrangement (1)  (time =) $\frac{9360}{0.4}$ or time = $\frac{\text{work done}}{\text{power}}$  evaluation (1) $23400 (s)$  conversion (1) $6.5 (hrs)$	substitution and rearrangement in either order  accept rearranged equation given in symbols  allow $24000 (s)$ using $0.39 (W)$ allow $23\ 963(s)$ using $0.3906 (W)$  allow $6.67/6.7 \text{ hrs}$ if $0.39 (W)$ used  allow $6.6/6.656$ hrs if $0.3906 (W)$ used  correct answer without working scores 4 marks	4
2 (d)	substitution (1) percentage error = $\frac{0.01}{1.11} \times 100$  evaluation (1) $0.90 (\%)$	allow $0.9 \%$	2



2(e)	<p>prediction does not fit the {trend/ pattern } (1)</p> <p>any <b>one</b> from</p> <p>the trend shows the increase ( from 6 to 7) should be less than 0.30(A) (it is 0.46(A)) (1)</p> <p>data shows that the increase in the current gets smaller as more lamps are added. e.g. 1 to 2 lamps increase 0.46(A), 5 to 6 lamps increase 0.30(A)(1)</p> <p>the increase is getting smaller by 0.04(A) each time a lamp is added (1)</p> <p>7 lamps should give (0.26(A) bigger(1)</p> <p>7 lamps gives an answer of 2.78(A) (1)</p>	<p>no marks for comment related to prediction being correct or incorrect without reference to a trend or pattern or supporting evidence. supporting evidence can be seen on the table in the question</p> <p>the supporting evidence must include data obtained from the table</p> <p>allow values that round to 2.8(A)</p>	2
total			16 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	<p>An explanation that makes reference to one linked pair:</p> <p>using the same cell/battery (1) to keep the (initial) voltage constant OR use identical lamps (1) which have the same resistance/take the same current OR make good (electrical) connections between all the components (1) (so) there is little/no contact resistance (1)</p>	do not allow powerpack	2
3b	<p>An explanation that makes reference to both of the linked pairs:</p> <p>repeat the experiment (1) using the same apparatus/equipment (1) AND other learners carry out the (same) experiment (1) comparison of results (1)</p>	do not accept method	4
3c	<p>An explanation that makes reference to any two of the following pairs:</p> <p>use lower voltage lamps (1) to find the minimum voltage lamp to be used (1)</p> <p>add more cells/ batteries /lamps (1) to increase the range of readings (1)</p> <p>use different types of cells /batteries / lamps (1) to see if the results are the same (1)</p> <p>put lamps in series (1) to see if the circuit behaves in the same way (1)</p> <p>use wires with good electrical contact (1) to reduce contact resistance (1)</p> <p>Any other sensible suggestions</p>	<p>Accept for one explanation only ' see if results follow a similar pattern'</p> <p>Do not accept power pack</p>	4
total			10 marks

Question number	Indicative content	
4	A plan that makes reference to: <ul style="list-style-type: none"> <li>• a hypothesis</li> <li>• equipment techniques and /or procedures</li> <li>• risks</li> <li>• control variables</li> <li>• dependent variables – how it will be measured, units and the precision of measurements to be taken</li> <li>• independent variable – the range of measurements/categories to be used and how they will be measured, the intervals to take measurements</li> <li>• data analysis.</li> </ul>	
<b>Mark scheme (Award up to 12 marks)</b> Refer to the general marking guidance found in this document on how to apply levels- based mark schemes*.		
Level	Mark	Descriptor
<b>Level 0</b>	0	No awardable content
<b>Level 1</b>	1-3	<ul style="list-style-type: none"> <li>• Limited attempt at a hypothesis is made</li> <li>• Demonstrates limited knowledge and understanding of scientific concepts, procedures, processes and techniques with a basic description of the plan to investigate the scientific scenario given</li> <li>• Provides a rationale for the method suggested and generic statements may be presented rather than linkages being made so that lines of scientific reasoning are unsupported or unclear</li> <li>• The plan will not be logically ordered with significant gaps that will not lead to reliable results being collected</li> </ul>
<b>Level 2</b>	4-6	<ul style="list-style-type: none"> <li>• An explanation for the hypothesis is given that is partially supported by scientific understanding</li> <li>• Demonstrates adequate knowledge and understanding of scientific concepts, procedures, processes and techniques with a partial description of the plan to investigate the scientific scenario given</li> <li>• Provides a rationale for the method, which has occasional linkages present so that lines of scientific reasoning are partially supported</li> <li>• The plan will generally be in a logical sequence and will yield some results</li> </ul>
<b>Level 3</b>	7-9	<ul style="list-style-type: none"> <li>• An explanation for the hypothesis is given that is supported by scientific understanding</li> <li>• Demonstrates good knowledge and understanding of scientific concepts, procedures, processes and techniques with a clear description of the plan to investigate the scientific scenario given</li> <li>• Provides a rationale for the method, which has linkages present so that lines of scientific reasoning are supported</li> <li>• The plan will be in a logical sequence but with minor omissions of steps and will yield reliable results</li> </ul>
<b>Level 4</b>	10-12	<ul style="list-style-type: none"> <li>• An explanation for the hypothesis is given that is fully supported by scientific understanding</li> <li>• Demonstrates comprehensive knowledge and understanding of scientific concepts, procedures, processes and techniques with</li> </ul>
		<ul style="list-style-type: none"> <li>• a step-by-step description of the plan to investigate the scientific scenario given</li> <li>• Provides a rationale for the method, which has consistent linkages present so that lines of scientific reasoning are fully supported</li> <li>• The plan will be in a logical sequence and will lead to a reliable set of results being collected</li> </ul>

Question number	Indicative content
5	<p data-bbox="387 293 1430 479"><b>Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some / all of the indicative content but should be rewarded for other relevant answers.</b></p> <p data-bbox="368 517 900 546">An evaluation that makes reference to:</p> <ul data-bbox="416 551 1509 1532" style="list-style-type: none"> <li data-bbox="416 551 1453 580">○ no volume of water has been stated so cannot be consistent across tests</li> <li data-bbox="416 584 1490 613">○ drop of food colouring is not measured so cannot be consistent across tests</li> <li data-bbox="416 618 1358 689">○ there is no way of standardising when the colour is spread evenly throughout the beaker</li> <li data-bbox="416 694 1481 766">○ adding food colouring to the side might mean that some could get stuck to the side of the beaker so the same amount will not be used</li> <li data-bbox="416 770 1362 842">○ no mention of how the water is heated so temperature may not be consistently maintained across the test</li> <li data-bbox="416 846 903 875">○ temperatures not evenly spaced</li> <li data-bbox="416 880 1506 952">○ no mention of specific equipment used e.g thermometer, syringe, measuring cylinder</li>   <li data-bbox="416 1016 1509 1088">○ 100°C is the boiling point of water therefore bubbles and movement of water will spread the food colouring so no longer just diffusion</li> <li data-bbox="416 1093 794 1122">○ precision of time is poor</li> <li data-bbox="416 1126 884 1155">○ has only been carried out once</li> <li data-bbox="416 1160 900 1189">○ not sure if data is correct or not</li> <li data-bbox="416 1193 1481 1265">○ data does support the conclusion that the rate is getting faster from 30° to 100°C</li> <li data-bbox="416 1270 1305 1299">○ but there is no evidence to support the conclusion below 30°C</li> <li data-bbox="416 1303 1493 1375">○ however could be getting slower between 50° and 60°C but hard to tell with data given to 1 sig fig C</li> <li data-bbox="416 1379 991 1408">○ should give data to more than 1 sig fig</li> <li data-bbox="416 1413 1099 1442">○ could take more readings such as 40, 70, 80°C</li> <li data-bbox="416 1447 1406 1476">○ there are no repeat readings at each temperature to take an average</li> <li data-bbox="416 1480 940 1509">○ the graph is not a line of best of fit</li> </ul>

Level	Mark	Descriptor
	0	No awardable content
<b>Level 1</b>	1-2	<ul style="list-style-type: none"> <li>• Adequate interpretation and analysis of the scientific information</li> <li>• Generic evaluative comments made with little linkage to supporting evidence/reference to context</li> <li>• A conclusion may be presented, but will lack focus and be superficial and underdeveloped</li> </ul>
<b>Level 2</b>	3-5	<ul style="list-style-type: none"> <li>• Good analysis and interpretation of the scientific information</li> <li>• Evaluative comments with supporting evidence/reference to context and a partially developed chain of reasoning</li> </ul>

		<ul style="list-style-type: none"> <li>• Conclusion will be mostly focused and developed and draw on some of the information presented before</li> </ul>
<b>Level 3</b>	6-8	<ul style="list-style-type: none"> <li>• Comprehensive analysis and interpretation of all pieces of scientific information</li> <li>• Evaluative comments supported by relevant reasoning and appropriate reference to context</li> <li>• Conclusion will be clear and concise and well-developed drawing upon the most relevant information presented</li> </ul>
		Total marks 8

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